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ABSTRACT

Productivity is a concept that can be defined in a variety of ways. However, as it pertains to higher education it has yet to be sufficiently understood to allow widespread practical applications. The author of this paper examines the meanings of productivity outside the academic setting and relates his findings to current management and planning approaches used by higher education administrators. He then suggests that higher education institutions need to experiment more with different productivity measures to determine the formula best suited to their individual needs. (Author)

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Foreword

Productivity is a concept that can be defined in a variety of ways. However, as it pertains to higher education it has yet to be sufficiently understood to allow widespread practical applications. The author examines the meanings of productivity outside the academic setting and relates his findings to current management and planning approaches used by higher education administrators. He then suggests that higher education institutions need to experiment more with different productivity measures to determine the formula best suited to their individual needs. William Toombs is Assistant Director at the Center for Higher Education at the Pennsylvania State University.

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ERIC/Higher Education
May 1973

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Overview

Education is a process of "converting tangible resources into intangible resources" (Henderson 1971). This is a truism no amount of manipulation can alter. But truisms are often hard to live with. From time to time those in education along with external observers have found the need to specify the process in quantified terms thought to be more accurate and more readily understood.

In the recent past higher education achieved substantial success in producing what society required of the enterprise. Key decisions of the last 15 years reflect healthy vitality in the academic world and Harris (1971) has provided a compendium of supporting statistical evidence. Ben-David (1972) has given a view of that success through a visiting scholar's eye, tempered by a balanced awareness of the problems. The magnitude of the accomplishments is clear in even a few indicators: educational levels in the population 25 years and over showed 10.7 percent *completed* 4 years of college or more when the 1970 census was taken, up from 4.6 percent in 1940. In the age group 18 to 21, about 55 percent were enrolled in formal education compared to 16 percent 30 years before. In 1960 an OECD conference set estimated goals for the share of Gross National Product that might go to education. For the U.S. the 1970 target was 5.26 percent of GNP; however, by 1965 the level had already reached an estimated 6.4 percent (Gass 1969, p. 216). This was due in part to the fact that a whole new class of institutions, 2-year colleges, had entered the national scene, numbering over 1,000 by 1970. At the most advanced level, post-doctoral study, an "invisible university" developed with an enrollment of 16,000 by 1967 (National Research Council 1969). Clearly the "industry" identified as higher education developed and successfully demonstrated an enormous capacity for production.

But successes, like truisms, are also hard to live with. Each added increment of productive capacity cost more for reasons found partly in the economy and partly in institutional policies or academic tradition (Cheit 1971). A recent Carnegie Commission Report summarizes the condition with an estimate that the yearly rate of increase on costs is running 7.5 percent. Only 2.5 to 3.0

percent is attributable to inflation. The remaining share represents increases generated by the traditional practices of education (Carnegie 1972, p. 4). Bowen (1972) finds the increase more modest, 3 percent a year in constant dollars, when the period from 1956 is considered; a formidable figure but "not the runaway condition sometimes alleged." The cost rise is coupled with a leveling of revenues.

Jenny and Wynn (1972) attack the problem in another way in their report on 48 colleges. Between 1968 and 1970 expenditures rose 10.3 percent (annual compound growth rate) while total income increased 8.9 percent. Although these conditions raise immediate difficulties, the future prospects generated by the trends are an even greater concern. For the next dozen years higher education will face growing enrollments. About 3 million more students are expected, and other university activities such as research and public service will grow as well to meet even modest expectations of society. The task is to hold annual rates of increase on all costs to a level nearer that of the general economy plus 2.5 percent over the inflation rate, rather than the plus 5 to 7 percent of recent years (Carnegie 1972, p. 9). Thus, the question of the 50s and 60s, Can higher education produce enough?, answered positively, has come to its new form, Can production be maintained and increased without a steep rise in unit costs? Business and industry met this problem by increasing productivity. Higher education is inevitably led in that direction.

The social and personal benefits produced by colleges and universities are desired and respected. One finds no signal of widespread rejection of what education has to offer and few signs of "a disillusioned and ungrateful public" (Hodgkinson 1972). Understanding of the process may be incomplete and questions are raised about management, but there is time and opportunity for the academic community to respond to the productivity issue on its own terms. The productivity issue is a burden of success, not a consequence of failure.

There is little confusion about the definition of productivity: outputs of a process are related to inputs and the relationship is taken to indicate productivity. The difficulties arise in making the concept operational and applying it. First, there are problems of measurement. What to measure and how to quantify is especially difficult in the service sector. Second, and more serious, there is the problem of interpreting the ratios and their relationships to each other. Third, and most serious, there is the problem of

finding "a suitable theoretical framework in which to organize the factual knowledge of productivity" (Salter 1966, p. 4; Gold 1971, p. 20).

The word productivity itself is unwelcome in many academic conversations as wholly inappropriate to higher learning. But compared to many of the other service activities, education has a clear production function in generating new knowledge and in creating a pool of more able individuals. It is not just a facilitative, restorative, or preventive enterprise, even though its product or value-added properties may be hard to capture.

Beyond productivity improvements, there are other alternatives to meet the cost dilemma. Some of these are shifting some costly functions to other agencies (e.g., student aid, construction, or financing); turning over marginal educational activities to high schools, industry or specialized proprietary entities; and mounting a campaign to increase income from public and private sources. Nevertheless, the subject turns continually to improving productivity, or at least demonstrating it, as a fundamental approach.

This paper considers productivity adjustment – modifications to inputs, outputs, and production processes – as it currently appears in higher education. It is not an economic treatise. The purpose is to assess those applications that fit the productivity idea, those at odds with it, and those being developed. A major part of the task of improving productivity lies in demonstrating improvement in terms that are widely understood. The productivity analogy has that advantage. The first chapter provides a definition of productivity along with the advantages and limitations in the idea itself. The second chapter considers the reasons for its appearance in higher education and the peculiarities of that setting. The third and fourth chapters deal with adjustments to inputs and outputs. The fifth chapter considers the production process and the problem of adjustments to the process, and the final chapter presents the conclusions.

A few boundaries must be established because any discussion of resource allocation leads easily into the whole spectrum of economics and management or escapes into global questions of public policy. In general the macroeconomics of education and its productive role in the total economy will receive only incidental attention. Management techniques and systems analysis, representing the richest strain of contemporary literature, are often

summarized briefly in the commentary, but the references have been selected to give detailed coverage.

The level of approach is at colleges or universities, since that is where gains must be made and losses confronted. There are solutions to the productivity problem that lie outside the traditional educational approach (the external degree or the open university are the most intriguing), but the heart of the productivity problem is on campus.

Some outcomes to be kept in mind lie at the edge of expectation and beyond the capacity of management. First, the role of higher education may be perceived as so vital to economic growth or social and political stability that it will be extended at any cost. This has already been part of our national experience and may not yet have run its full course. Second, the contrary condition that has not been part of the American experience, i.e., major cutbacks in educational opportunity especially at the advanced levels, is also a possibility beyond the productivity question. Third, the question is also bound up in a number of factors beyond the range of manageability that act to increase costs: accumulation of knowledge and technology, the rising skill of the labor force, and new concepts of social justice and decency (Vaizey 1962; Bowen 1972). Fourth, the Carnegie Commission suggestion of a cut in annual rates of growth for costs from 5 percent to 2.5 percent over inflation is exceedingly ambitious. Nothing in the experience of other labor intensive professions holds much promise that it can be done—neither the performing arts nor medical services or the courts, and certainly not the military, where much of the technique had its genesis. A more realistic assessment notes, "To reduce the annual increase in (deflated) cost per student from the recent 3% to 2% per year would be a major accomplishment" (Bowen 1972, p. 192). Borrowing from business practice is also an unlikely solution, although a few recent introductions are worth considering (*Business Week*, 1972). Nevertheless, the stakes are high in the search for improved productivity and any savings in an enterprise that spends 37.3 billions of dollars a year and employs a large share of the professional labor force will carry internal as well as societal benefits (Bell 1971, pp. 8-13).

Productivity: The Tantalizing Idea

The Essential Definition

The notion that a relationship between inputs and outputs has special significance is as self-evident as it is fundamental. Ratios between the two in a time series indicates whether a production process is tending toward greater or lesser efficiency. Although simple in the extreme, the idea has two advantages: first, elementary forms of input-output ratios are easily communicated to a variety of audiences because they fit a wide range of familiar analogies; and second, by applying input-output ratios at various points in a complex activity system, it is possible to focus analysis at the crucial locations.

Productivity was not developed in an orderly way under the conceptual umbrella of any single discipline. What began in economics and mechanics was applied by a variety of specialists to the problems at hand by the expedient of twisting the concept to fit. As a consequence, there is no coherent body of literature that can be readily isolated and examined. Gold (1971, p. 33) distinguishes two quite different origins. In the agricultural lineage, emphasis was laid upon inputs of varying types and amounts applied to land of similar fertility to give marginal increases in outputs. This is the "input creativity" approach, i.e., inputs "cause" outputs. The other view takes the machine as the model and places the emphasis on the process by which as much of the input as possible is converted into output, with the ratio itself as a measure of efficiency. The transformation of fuel into energy is the example of "conversion efficiency." The process "causes" the change in outputs. There is no model for human development systems and this lack has hampered both analysis and the gathering of information (Rivlin 1971, p. 64). In speculating on the future to 2000 A.D., Thurow (1972) sees a need for indexes of social welfare parallel to concepts like the Gross National Product to assess outputs beyond marketable goals and services. In the meantime the traditional tools have their place.

The economic definition is summarized by Fabricant (1968):

> Productivity . . . refers to a class of empirical output-input ratios that is widely used in economic history, economic analysis, and economic policy. In one sense, productivity measures the

> fruitfulness of human labor under varying circumstances. In another sense productivity measures the efficiency with which resources as a whole, including capital as well as manpower, are employed in production. In still another sense, productivity measures the forces that underlie the trend of real wages. And in a fourth sense, productivity measures a major factor in the determination of labor or capital requirements. Productivity measurements are addressed to important questions . . . . Some questions are best answered with one kind of productivity measurement, and other questions with other kinds . . . . In addition, there are some forms that simply reflect the dearth of statistical information (Fabricant 1968, pp. 523-536).

Another economist sharpens the emphasis:

> One of the reasons why interpretive analysis of productivity has been slow to develop has been the interminable controversy over what is productivity and what do we really wish to measure . . . . Much of this discussion has proved fruitless and only served to confuse the issues of measurement with the issues of interpretation. Unless there is a revolution in statistical techniques and information only one type of productivity concept is measureable. This is the concept of output per unit of input (Salter 1966, p. 2).

Stripped to essentials productivity involves three ideas: input, output, and process, including a ratio to describe the input-output relationship. The question as to where it is most appropriate to apply these ideas, what emphasis should go to each element, how the ratios can be constructed or interpreted, and how the component factors can be manipulated to best advantage is the object of much debate. There is an implicit assumption that most of the input and output factors can be controlled and that the core of the process can be identified with some certainty (Gold 1971, p. 37).

Ratios as Indicators

An emphasis on the ratios of inputs to outputs alone has been called the "black box," or better, the "one armed bandit" approach. One pulls the lever (input), reads the windows (output), and collects the increased productivity in the form of winnings (Armitage 1969). At first glance this simplified view seems to lend itself to exhortation rather than explanation, e.g., " . . . the nation

must make a gargantuan jump in efficiency. It must get more output from its men and machines" (*Business Week* 1972). Economists have found, however, the comparative performance of these simple indexes over time to be highly useful. Solow (1963) notes, "The economist really need not know at all what it feels like to be inside a steel plant. . . . He quantifies technological change by making measurements of . . . output per unit of this or output per unit of that."

Ideally a productivity index includes all the inputs and a representation of all the outputs to give "total factor productivity." This condition is never achieved and one of two broad modifications is selected. "One includes those measures which relate output of a producing enterprise . . . to one type of input such as labor, capital, energy, etc. The other includes those which relate output to a combination of inputs extending to a weighted aggregate of all associated inputs" (Mark 1971, p. 12). So there is total factor productivity and single factor productivity, with actual practice falling somewhere between.

One of the broad gage measurements of productivity, Department of Commerce estimates, provides rough normative indexes. For example, total factor productivity for U.S. nonfinancial corporations grew between 1948 and 1971 at an annual average rate of 2.2 percent, corrected for inflation. Labor productivity during the period grew at a 2.8 percent rate. In the most recent decade, 1960-70, total factor growth rate was 2.5 percent a year and the single factor of labor increased in productivity at an annual rate of 3.1 percent. However, at the same time there was a "massive substitution of capital for labor" with capital inputs rising at 4 percent per annum (*Business Week* 1972).

Can this kind of multifactor productivity be useful in higher education? Useful but not definitive is the quick answer. Several index ratios, student-faculty ratios for example, have a long history newly updated and expanded by the Carnegie Commission Reports. The use of these data for purposes beyond guidelines and internal analysis raises serious questions. Among institutions of the same type, variations are wide and the reasons for dispersion unclear. The value of means or medians as prescriptive or even normative standards is limited. A more significant problem stems from the way these data are used in the decisions of review bodies or allocating agencies. The link between well-developed information and policy decisions is highly uncertain. Preference for one

ratio over another is more a means of excusing a decision than shaping it. Of basic concern is the tenuous attachment of these indicators to the educational process: "Unit cost per credit hour is an interesting number but it has absolutely nothing to do with education . . . " (Hodgkinson 1972). But reporting is improving, comparability is growing, and the historical series are receiving more analysis. These general indexes are here to stay.

One group of ratios is nonmonetary: faculty fulltime equivalent (FTE) to student fulltime equivalent; FTE faculty to student credit hours (SCH); FTE faculty to contact or classroom hours per week or sometimes per term; degrees granted to enrollment; degrees to FTE faculty. While these are common indicators, the possibilities are infinite for matching fundamental resources such as space or library usage with student population or faculty.

The cost-related set is also widely used. Dollar costs of total or selected inputs to students, credit-hours, and degrees can be refined to college or program levels or treated as an institutional indicator.

Student-faculty ratios, the old standby, have actually increased in recent years and illustrate one of the dilemmas of policy formation noted above. In 1955, the average ratio for 4-year institutions was 13.8 and by 1967 had increased to 15.9, with the tendency appearing in all types of institutions. Is this a satisfactory gain? If not, is a reasonable level twenty-two for public research universities, as a Carnegie Commission Report suggests, or perhaps 25 to 30 (Carnegie 1972, pp. 65, 85)? Obviously, in our present state of knowledge the choice is largely independent of accurate information (Carnegie 1972, T12, p. 82).

Student credit-hours per faculty member also has a long history (Hefferman 1973). In recent years, this unit has become less standardized; but some state workload legislation (e.g., Michigan) provided definitions in terms of student credit-hours or contact hours. Contact hours or classroom clock-hours per faculty member have exhibited a decline from about 15 hours in 1931-32 to a range of 7 to 11 in 1969 (Carnegie 1972, p. 69).

The granting of a degree is a focal point at which the interests of the student, the expectations of society, and the certifying function of the institution meet; consequently, ratios of degrees to fulltime equivalent students have considerable significance (Toombs 1973). This relationship was considered for graduate

students in the sciences by Consolazio (NSF 67-6) who introduced a refined weighting and also related the information to costs. As a measure of departmental productivity at the doctoral level a weighted relationship of degrees, time elapsed, and FTE faculty has been developed by Hey (1970). Cartter (1969, p. 175) presented a useful summary of the three measures discussed above broken out by discipline and by quality of institution.

Demonstration of improved productivity by cost ratios has proven to be a major challenge. Costs represent a collection of undifferentiated inputs, such as salaries, supplies, services, and capital costs. Thus the unit cost per degree or per enrolled student is an index of multifactor productivity. Costs per student have increased from $1,007 in 1959-60 to $1,772 in 1970 (Carnegie 1972, p. 35). O'Neill (1971) studied the period 1930 to 1967, comparing student credit-hours adjusted for level of study with a cost input composed of instructional costs and an ingenious estimate of capital costs. Her conclusion is that "there is the strong possibility that there has been no productivity change . . ." (O'Neill 1971, p. 49).

Multifactor ratios for higher education will have to be developed more fully over the next few years. Dependence on faculty input alone is already a serious distortion of reality, and as library, computer, support, and administrative functions take an increased role in the educational process, they must be accounted for.

The Production Process

However useful productivity rates may be as general indicators, they convey little information about the actual process of converting inputs into outputs. Adjustments to this conversion process are an obvious source of improvement and the question arises as to how much must be known about the process to make effective changes. At first glance it might appear that every detail of the process should be known but this is unfeasible in all but the simplest production process and utterly impossible in education. In a complex activity system the meaningful production subsystems need to be specified and, most importantly, the relation of one subsystem to another needs to be known.

One approach to process analysis is proposed by economists. Rivlin (1970, p. 70) puts the relationship succinctly:

> The analysis of education rests on two premises. The first is that at least some of the important outcomes (outputs) of education are identifiable and measureable . . . . The second is that fairly stable relationships exist between these outcomes and the 'inputs' to the educational process . . . . A reasonable working hypothesis holds that education influences learning in some regular and discernable way, that education has, in economists' jargon, a 'production function' – some functional relationship between the types and proportion of resources used and the results produced.

In a symbolic form the relationship is suggested by the equation $A = F(X_1, \ldots, X_m, X_n, \ldots, X_v, X_w, \ldots, X_z)$. Where A equals a measure of output, $X_1, \ldots, X_m$ equals environmental variables, $X_n, \ldots, X_v$ background factors outside the environment, and $X_w, \ldots, X_z$ equals student ability level and initial knowledge state (Bowles 1970). The parameters of the function f are to be estimated and the form of this estimation (linear, co-linear) and the formula developed. Perl (1969) described an experimental application to higher education and has continued a study of factors affecting completion rates. He notes, "The production function allows us to analyze the nature of educational technology on the basis of a relatively limited number of observations on the workings of the *process in the past*" (Perl 1969, p. 70).

Another means of looking at the whole production process and accounting for its interdependences without minute descriptions of operations is through "productivity networks" (Gold 1971). Briefly, this idea involves the identification of the most significant production subsystems in the total operation. For each, a set of "managerial control ratios" is developed to reflect those elements that link into the prior process as well as the next stage. Only the significant interrelated information is gathered and accumulated into indexes. The approach has proved useful to business in identifying low or negative productivity effects usually masked by conventional reports (*Business Week* 1972, p. 142). Direct applications have not yet appeared in higher education but the basic notion of a managerial network of critical ratios fits well with the current trend of systems analysis.

Research into the actual operations of production–the teaching-learning process in education–has its own significance. To begin with "substantial increases in productivity will likely be achieved only through changes in the educational process itself. . . . In higher education, such changes can occur only with

experimentation and innovation in academic programs, in instructional techniques, and in the relationships of the student to the institution" (Smith 1971, p. 127). Second, the education production process consists of two quite different activities: (1) the creation and maintainence of an environment, and (2) within that environment, the exercise of professional and highly personalized skills in a client-centered situation. Managerial practices have great influence upon productivity by optimizing environmental conditions and the mix of professional talent. Beyond management lies professional practice, and this phase of productivity requires more detailed experimentation and analysis.

Related Terms

There are several other terms used to analyze productivity phenomena. Although they appear to be independent, they arise from specialized input-output groupings or from efforts to counter the limitations of the idea.

> An examination of the literature with its use of 'output budgeting,' 'cost effectiveness,' 'systems analysis,' 'efficiency auditing' and similar phraseology, might suggest to the uninitiated that a variety of methods have been developed for the treatment of this question. The differences in nomenclature, however, primarily refer to the scale or content within which a particular problem is being tackled and should not mask the underlying unity in the basic approach. Essentially, the approach is one which seeks to identify the 'outputs' or 'objectives' of each expenditure program in a measureable way, and then to determine the cost patterns associated with the attainment of these outputs (O'Donohue 1971, p. 150).

Among the terms that have gained wide acceptance are cost-effectiveness and cost-benefit. Coombs (1972, p. 82) has linked *cost-effectiveness* to the internal efficiency of an educational system. This ratio measures the cost of achieving immediate outputs as opposed to more distant benefits. These outputs should be expressed in terms of performance requirements that take account of the constraints and standards of the system (Tanner 1971, p. 61). The *cost-benefit* idea reflects "external productivity." Costs take on the character of an investment and the outputs are the rate of return over a long time period and in the larger dimensions of the economy. Coombs (1972, p. 83) notes that "paradoxically, an educational system can have high internal efficiency yet low external productivity." Examples are found

when education concentrates on teaching that has little relevance to student needs or societal requirements. Elaborate techniques for analysis are available to estimate the cost-benefit of major programs by evaluating consumers' surplus, accounting for transfer payments and spinoff effects, and discounting inputs (Mishan 1971).

Occasionally the term cost-benefit is encountered to describe this approach (Hamelman 1972, p. 116). "The benefit-cost method involves a comparison of the present value of benefits with the present value of costs of the same program, using some appropriate interest or discount rate to adjust future dollar values into present dollar equivalents . . . . Ideally one would like to consider nonpecuniary benefits and costs together with pecuniary ones." Because of its complexity and the scale of the assumption that must be made, this technique of projecting input-output ratios is best suited to major projects, e.g., the evaluation of a plan for a new medical school, rather than to day-to-day management.

Advantages and Limitations of the Productivity Approach

Two Advantages – The advantages of an input-output approach are few but substantial while the difficulties are complex and persistent. Productivity ratios are easily communicated to individuals with a variety of backgrounds who hold limited knowledge of the activity system being described. Higher education is in exactly such a state in its relationship to public bodies. The intricacies of the academic profession, of research and public service, and of supporting activities cannot be explained fully but the effects are partially conveyed by simplified indicators of input and output for institutions. The second advantage or set of advantages resides in the range of applications that can be made at various levels of a production activity, i.e., department, program, college, or statewide system. Ratios of input and output can be applied to almost any units and then built up into meaningful networks (Gold 1971). Complexity develops along with rudimentary knowledge, thus providing an heuristic quality to productivity analysis. There is also a directional quality implicit in the approach always toward increasing productivity and improving ratios. What the productivity idea lacks in elegance it makes up in utility as a first approach.

Limitations – Even as an idea productivity has intrinsic limitations and they are multiplied by the problems of measure-

ment and interpretation whenever one moves to application. First, productivity is not a theory but rather an approach to theory or a descriptive tool. Gold (1971, p. 36) makes the point clearly: "juxtaposing the comparative magnitudes of specified inputs and outputs reveals nothing more than the level of, or changes in, the given ratio. To evaluate such quantitative findings, the variables should be derived from an analytical framework which encompasses all of the inputs and outputs of the system and provides a theory of how it functions . . . productivity measurements cannot provide the basis for a theory . . . of effectiveness in marketing, education, or research." In education "the crucial deficiency is not in the lack of data but in the absence of a theory of learning to guide us in establishing a model for estimation" (Bowles 1970, p. 12).

Second, productivity is not a monistic concept. Within any organization there is a hierarchy of productivities and many of them exist independent of the central goals of the organization (Thorelli 1960). Pluralism within the organization is matched by the absence of any single standard or measure that will apply across organizations. This lack of "a unitary concept which is widely applicable means that productivity studies cannot undertake to measure the efficiency of a given activity system" (Gold 1971, p. 39). It can measure only specified performance objectives, a limitation continuously troublesome to education.

Third, productivity ratios are point-by-point measures and the dynamics of change are poorly treated. This "inability of static equilibrium concepts to analyze continuous processes through time" (Salter 1966, p. 4) also means that all information is provided *ex post facto.* Analysis is a captive of past events and adjustments can be judged only after the process has run its course. Finally, the use of an arithmetic ratio imposes requirements often overlooked. The nature of inputs and outputs must remain stable during the period of study in order for productivity to be measured. Education falls victim to this limitation because improved quality in either inputs or outputs is seldom fully accounted for in conventional indexes. Those items selected for quantification should be at the core of the process and they must be expressed in units that allow output to bear some known relationship to input.

In summary, input-output ratios offer an analytical and descriptive device of great simplicty that can be applied to many levels in a complex organization. The ratios are an excellent means

of communicating information about detailed operations to inexpert publics. Each of these virtues touches a need of higher education, but the second – demonstration of effectiveness and efficiency – is vital. In a sense the limitations are the obverse of the benefits, e.g., absence of a comprehensive theory, lack of a single standard, the *ex post facto* quality of information. The combination suggests that input-output analysis is a good place to start, but we should not expect it to yield sophisticated results.

Higher Education: A Special Case

Origins of the Productivity Issue

Recent emphasis on demonstrating productivity in colleges, universities, and state systems of higher education has origins on and off the campus. There has been a new insistence on "formal external accountability" that has taken several forms (Mortimer 1972). One dimension deals with a report and justification of the use of funds not just in the fiduciary sense but in terms of effectiveness. Institutions have always acknowledged responsibility to a number of constituencies, e.g., alumni, donors, and perhaps a single public agency. But the number has increased to the point where the average public institution may be accountable to four agencies and the number could easily reach seven (Maynard 1971, p. 29; Balderston 1970, p. 11).

Why this new accountability and why in terms of productivity, a concept usually applied only to the industrial sector? One answer lies with the setting in which accounts are rendered. Even an auditor's statement of accounts is not self-evident or independent of assumptions. Whatever the form of the statement may be, it is considered in an ambience that ranges from simple trust or good faith to understanding, on to negotiation, and finally to coercion. Until about 5 years ago higher education tendered its accounts in an atmosphere of good faith and traditional acceptance. Functions were few and goals were believed to be self-evident. As the number of functions increased, the setting of accountability in higher education began to move from belief and faith toward understanding and knowledge (Pratte 1972). At the same time certain underlying assumptions began to shift.

In common with a number of other service activities, education was judged by the standard that higher costs inevitably meant higher quality. This popular notion corresponds with a device of convenience used by economists when the value of outputs cannot be established by conventional pricing theory. They assume that the money value of the outputs that cannot be valued is at least equal to the value of inputs that can be priced (Vaizey 1970). This assumption is under question, since price may equal value at the lower stages of service; however, there comes a point

in development when this is not true. Now the emphasis shifts to an independent evaluation of outputs by value-added cost-effectiveness or cost-benefit. Finding a common ground of knowledge and terminology for exchange with a variety of agencies has been difficult. The simple ratios and analogy of productivity ratios offer a suitable starting point for such exchange.

A second reason for the emergence of productivity ideas in higher education is internal and lies in the need for management decisions. The management tradition, not that old itself, claims special ability in optimizing the use of resources by sorting out mixed goals and rationalizing internal relationships. Neither of these conditions presented a problem in higher education until the late 60s. When the growth curves in resources began to level off, a host of unheeded factors appeared. One of the first realizations was that universities and their faculties were serving far more objectives than anyone realized (Heinle 1967). They had become agencies of applied research, instruments of social amelioration, and significant participants in the financial world through student loans, construction bonds, and invested endowments. All this accompanied the traditional functions of teaching and basic research. A second realization was that very little coherent information was available in a form that would encompass the whole enterprise. More slowly, and still growing, came recognition that there was a network of interdependencies among the activities of departments and colleges that reached beyond institutional boundaries in ways that had not been appreciated. This combination of conditions – limited resources for multiple goals in a decentralized organization whose interdependent units operate under an impression that they are autonomous – is the substance of management decisions.

In the academic ranks there is a suspicion that identification of management decisions prefigures a managerial structure very different from the mixed collegial-bureaucratic organization now in existence. It is true that current issues often overtax traditional forms of campus governance, since faculty committees and senates have limited ability to handle large amounts of information in unfamiliar forms. The skills and techniques of management experts illuminate these situations with apparent ease and structure the alternatives. There are just enough proponents of a manager corps as the new academic decisionmakers to give substance to faculty suspicions (Leslie 1970; Hamelman 1972).

The Carnegie Commission identifies a "middle-management" group to provide staff support for the president, with faculty accorded an advisory role (Carnegie 1972, pp. 18, 26). There are large undetermined elements in such a relationship, particularly for faculty who in the last decade have built a strong pattern of influence over institutional decisions. Much of the information noted has no implicit norm and the standard for its use must be set by the political process. One factor in the movement of faculties toward collective bargaining is the need to influence more directly in management decisions. The nature of the organization that finally emerges to deal with these decisions is actually a separate question. Whether they are made by a manager-czar or by a faculty committee, the management decision is a requirement of the situation.

How Special is Higher Education?

Opinion as to how applicable the idea of productivity is to the academic setting spans the range from complete acceptance (Radner 1970; Blaug 1969) to complete rejection (Wescoe 1970; Pake 1971). There are, indeed, attributes of education not adequately accounted for by the input-output approach.

A *labor intensive* activity, education uses 65 to 80 percent of the instructional budget for faculty salaries and delivers services in what Fuchs (1965) calls a highly personalized manner. Along with the medical care and justice systems, higher education displays economic characteristics of imperfect competition, a low capacity for substitution of capital for labor, and a need for innovation to be embodied in the practicing labor force before it can take effect. Productivity measurement in the service sector has shown "considerable margins of uncertainty" (Fuchs 1967). Because professional labor represents a large share of costs it has been tempting and quite in line with industrial practice to fix upon faculty labor as the determinant input. Productivity per faculty member in terms of some convenient output, e.g., student credit-hours, is offered as an index of effectiveness. Unfortunately, this propagates two errors that obscure much of what occurs at the university. First, it feeds the notion that faculty only instruct and does not identify the areas of research, administrative effort, and public service. The second error confuses instruction and learning. Much of what faculty do beyond instruction contributes to

learning, just as student efforts beyond the classroom are part of learning.

A *quality intensive* condition is also present. The way in which education is carried out affects the outcomes. Like the symphony orchestra and repertory company reported upon by Baumol and Bowen (1966), the quality and style of educational performance is part of production and difficult to measure. One consequence is that technological improvements and much of capital investment have gone into the quality of the experience rather than into measureable outputs. Economists have noted that "in most industries new technology tends to cut costs but in higher education it has the opposite effect" (Bowen 1969). Investments in personnel, such as more doctoral and postdoctoral training among faculties and more highly trained librarians or laboratory technicians, also enhance service without improving quantitative results.

Knowledge futures might be used to describe the product generated by higher education. At the point of the degree nothing is completed except formal preparation. And this is the "commencement" of real output for the individual and society that should not cease until a career has closed. This means that all measures of output at the point of graduation are fundamentally incomplete.

The *peculiarity of organization* in universities and colleges stands in the way of easy application of the production idea. "The main pattern of academic organization is associational rather than bureaucratic. It does not stress 'line' authority, since basically all full faculty members are formal equals. . . . Indeed relative freedom from authority of organizational 'superiors' is one of the main aspects of academic freedom" (Parsons 1968). This mixed bureaucratic-collegial structure is not fixed by any means, with the result that administrative style plays an important part in the decision process. "Executive officers who assume they are acting within a formal, hierarchical structure soon find out that academic collegiality and strict organizational accountability are incompatible" (Weathersby 1972).

The *process of production* in higher education, if one concedes that production is the right word, has several distinctive characteristics. The professoriate represents a subsystem that generates both outputs and inputs to the institutional system. Faculty efforts in teaching are clearly inputs, while publications, patents, reports, and speeches are outputs. This "meta-

production," as von Weizsäcker (1969) identifies it, is conducted in the form of professional practice in a context where individual autonomy is great and management control is small. In research and teaching there are areas of professional prerogative that cannot be violated. This means that change is never complete until it becomes part of professional practice.

The most severe critics feel that pursuit of the production model has led to: (1) overemphasis on direct instruction to the exclusion of other functions of the university; (2) adoption of faculty time as a proxy for all the elements of instructional inputs; (3) acceptance of such fragmentary measures as credit-hours to indicate outputs that are much more complex; (4) inattention to the process of learning; (5) public usage of measures that reflect almost none of the improvement in quality that have occurred in educational practice; and (6) disregard for professional independence.

Taken together these conditions do not deny the possibility that productivity analysis and adjustment can fit higher education. They merely suggest that a great deal of the essential thinking is still to be done.

New Uses for Old Ratios

Equity — Using the productivity idea to justify the execution of a public trust is a relatively new application. In the past, the purposes of productivity analyses in the academic sphere have been quite different and many of the techniques used to assess productivity were developed around these earlier purposes.

Much of the early attention to faculty activity was motivated by the search for an *equitable work load.* The chapter on "Instructional Load" in the classic study by Reeves and Russell opens with this sentence: "One of the most difficult problems confronting a college administration is that of equalizing the loads of members of the teaching staff" (Reeves 1929).

Even contemporary attention to the question of faculty effort reflects this concern. The University of Texas faculty study notes: "It is also anticipated by the committees that the Faculty Work Load Formula System will provide an equitable method of balancing faculty work loads. . . " (University of Texas 1971).

Planning — When enrollments began to rise rapidly in the early 60s, the context of the faculty workload question altered. The WICHE Seminars in 1961 and 1962 dealt with the *short-range*

planning for new faculty to meet the imminent need. It was only a small step to the use of similar data for long-range planning, and this motivation appeared in the mid-60s.

It was also at this point that new considerations appeared in the form of *statewide planning*, often for multi-institutional systems of colleges and universities. Hitherto, information on faculty workload had been used largely within the framework of a single institution, though there had been tentative efforts to analyze state systems. John Dale Russell and James I. Doi had given careful attention to a variety of measures that might be applied to higher education and concluded that for "measuring economy of operations, the most relevant are those that show efficiency of use of faculty manpower." For their consideration of the New Mexico System, Russell and Doi found the best single measure for their purposes to be the "average student credit number hours per full-time faculty members" (Doi 1961). But even the proponents of these simplified indexes inveighed against using them without interpretation. Doi suggests certain guidelines to avoid exaggeration and misinterpretation.

> We continue to use student-faculty ratios and such units as credit hours and class hours because they are familiar concepts and part of the language of the campus. But all the while we know that such data are terribly misleading and hope that those who refer to them will be mindful of this fact.

But the demand for generalized information about university operations outstripped techniques that had been developed. So long as faculty workload data, credit-hours generated, or degrees produced were used for internal purposes it was possible to introduce corrections whenever good judgment seemed in jeopardy. Once a piece of data—a ratio or an efficiency index—came into the public domain, however, such refinements were no longer possible.

Control – With the onset of statewide planning, measures of faculty workload became synonymous with institutional output. They became instruments for comparing institutions and for estimating a system's effectiveness. Thus, devices that had been developed for self-examination became a medium for inter-institutional assessments. Partial indices that were meant to be used with careful interpretation were removed from those interpretations. Under economic constraints, allocating agencies picked up quantitative information at hand and turned it to serving still

another function, that of an instrument of *fiscal control.* Such data as contact hours, credit-hours per faculty member, and cost per fulltime equivalent student have become, almost unwittingly, the means by which representatives of the public interest assess the activity of higher education.

The Question of Levels — Continued use of these partial measures, application of them to purposes they were never intended to serve, and the indiscriminate shifting of ratios from one level of aggregation to another signal a makeshift technology in higher education that will have to be replaced. Of these, the most serious error is the misinterpretation of levels. Application of student-faculty ratios at the departmental and at the statewide system level offers obstacles to interpretation.

Gold (1971, p. 45) suggests that if ratios are to be used in decisionmaking they should relate in some way to the degree of control. He distinguishes the "control system" where decisions have a direct effect on resource flow from "group analysis systems," where the purpose of information is to reflect conditions in clusters of control units. The department, program, or college represent control units. Student-faculty ratios have considerable value at that level because they are directly affected by decisions. In most cases larger aggregations, statewide systems, have little direct influence on student-faculty ratios and, therefore, should forego this measure and design others that meet their specific interests. Ratios, if they are to be useful in decisionmaking, must be fitted to the condition of control at the level they are applied.

Input Creativity and Efficiency

Costs: Visible and Invisible

When productivity improvements must be demonstrated over the short run attention falls immediately on inputs. They are more easily identified than outputs in the service industries and can be translated into monetary values by conventional pricing methods. When a study is input-centered, then output may be assumed to be both constant and "an undifferentiated aggregate" (Thorelli 1960). A variant of this assumes that the value of all costs is equal to the output, with adjustments being made only at the input point (Vaizey 1970). This is the arena for "practical" solutions that every administrator and panelist must have at his fingertips. More carefully managed costs, greater use of the time and skill of personnel, and more intensive use of facilities — these are the principal manipulations available for immediate application (Carnegie 1972).

Cost reduction is an obvious source of productivity improvement, but in higher education actual costs of specific activities may be hard to determine. The traditional form of fund accounting and budgeting links allocations to administrative units rather than to specific activities. "What a company can do to boost its productivity depends heavily on how good its managerial accounting, control, and information system is," says *Business Week* (1972). This applies to educational institutions as well. The National Center for Higher Education Management Systems of WICHE has developed a set of cost-analysis procedures that will standardize terminology and increase the variety of cost data available to decisionmakers. Average costs and incremental costs can be determined for operating programs with assurance that many charges heretofore overlooked will be included (WICHE Technical Report 26). Replacing or supplementing the "incremental budgeting" system — where "ordinarily the programs of the current year continue and units chiefly negotiate the addition to their budget for the coming year" — is a necessary first step in costing (Cartter 1969).

The idea that costs are not self-evident led to the development of "cost finding" principles. These principles have three

roots: (1) Most programs have substantial costs that are easily overlooked or underestimated. (2) Similar institutions exhibit large differences in average costs. (Carnegie 1972, p. 45; Jenny 1972). (3) Patterns of change in costs differ among industries and among institutions rarely following a linear form (Carlson 1972). The first step involves the identification of operational units as cost locations and then assigning expenditures related to the activity. A share of the fixed costs of the institutional expenditures and a share of the variable support costs are also assigned. The history of changing perceptions of cost is covered by Powel (1970). The WICHE manuals on "Program Classification Structure" (Gulko 1971) and "Cost Finding Principles and Procedures" (Ziemer 1972) offer the details for design. A summary of general cost data for various types of institutions is provided by the Carnegie Commission report (June 1972, p. 85).

Adjustments to Faculty Input

Even without knowing the precise structure of costs there are obvious guides to reducing expenditures. With professional services representing a large share of total costs, it follows that any adjustment that brings more students under the tutelage of fewer professors promises to be quick and effective. The package of possibilities to give "more for less" (Smith 1971) includes reducing the number of course offerings, increasing class size, and curtailing undersize sections, e.g., those enrolling less than ten students. These methods are neither novel or untested. Rusk (1959) made his pointed and unheeded recommendations on class size 15 years ago. The Academy of Educational Development has reinforced them with empirical data on 80 institutions and abetted them with still other means of beating "the high cost of low ratios" (Moom 1971; Behrens 1972). For those who object on grounds that regimentation will be the only outcome there is the recent study of Bowen and Douglass (1971) which breaks down the costs of four instructional programs that are radically different in design and approach. This set of adjustments is clearly the most direct course of action available and it has substantial effects within a year on the student-faculty ratio, credit-hours per fulltime faculty member, and the cost per credit-hour.

An equally obvious method of increasing instructional productivity is to raise the class-hour load of faculty members. With one more refinement, a low average salary level for the

faculty, and the minimum cost package is achieved. In at least one instance, during the dramatic years of Parsons College, this package was tried (Koerner 1970).

A few years ago it appeared that faculty workload requirements stated in terms of credit-hours of class, contact hours, or student credit-hours might become the leverage for introducing new economies across statewide systems. In Michigan, Ohio, Florida, New York, Washington, Tennessee, Utah, and Pennsylvania, faculty workload data is separately reported (Hollowood [1973]). Even though Wisconsin, Kansas, Illinois, and Iowa have been studying the practice, general enthusiasm has waned and attention has shifted to more comprehensive funding formulae. While it may be too much to see in this slowdown a new understanding of the faculty as professionals, the new orientation does reflect appreciation for the complexity of college and university operations. A summary of factors in workload analysis and an evaluation of them is available in Romney (1971).

There are other aspects of the faculty that have begun to receive full attention. Rank structure and age have been of great concern because of their relationship to the change and vitality of an institution. Increasingly they will become a matter of economy. The Fleischmann Report of education in New York State to be published in spring of 1973 anticipates several input modifications that may be adopted by higher education. Much slower entry into the full professional status of a master teacher is anticipated though the use of several probationary levels. Paraprofessionals in larger numbers will further reduce personnel costs (Fleischmann 1973). A slight variation of this kind of labor modification is found in the extensive use of student employees in a wider variety of campus jobs (Bowen 1972).

Still another approach to faculty productivity examines the performance of an individual in the diverse phases of his professional life and not simply as a contributor to an instructional system. These studies, reviewed and expanded upon by Blackburn (1972), display a somewhat different picture than the summaries of system output. The workweek is consistently reported to be between 50 and 55 hours and, although the pattern of professional activities alters, a high level of activity continues through later years (Romney 1971, p. 36). Such studies emphasize the importance of that enclave of autonomous professional practice embedded in the production system of higher education.

Adjustments to Other Inputs

While adjustments that concentrate on faculty inputs give rapid and substantial effects, other changes in the form of substitutions, economies of time, rationalization and specialization of inputs, and more intensive use of existing facilities are all within the scope of possibilities.

Credit sources other than scheduled, formal, onsite classes have strong appeal. The ultimate substitution is the creation of a certifying agency with very limited instructional activity, just enough to give coherence to the programs, which accepts all work at accredited institutions. The "open" university is beyond this discussion but aspects of the idea are applicable to traditional institutions. Most institutions have contrived requirements that limit transfer credits or impose residence requirements. These can be removed. More liberal credit for work taken elsewhere through correspondence, commercial television, newspapers, and increased use of credit by examination, and recognition of evaluated experience are gaining wide approval.

Credit for off-campus experience is not without cost as well as quality questions. The substitution costs of many of these alternative ways to generate credit have yet to be worked out through pilot projects. These practices make it difficult for an institution to forsee accurately the numbers to be enrolled and all planning depends to some degree on future stability. More difficult to modify is the network of acceptance for these procedures. Bowles (1971, p. 29) emphasizes the extent of these networks: "Despite the wide range of substitutions that are apparently possible, the limited variability in the observed per student inputs suggests that a common technology is generally used. . . . [this] probably reflects the view among educational administrators that at any given time the appropriate input coefficients are roughly fixed. . . ." Shortening overall time for degree preparation has gained the endorsement of the Carnegie Commission (1971) after careful analysis. The initial adjustment for any single institution to a 3-year degree is financially severe but over the next decade the option will become common.

Operating an institution at capacity level throughout the year has strong attractions. The full complexity of this kind of decision is presented in an analysis by Weathersby of year-round operation at the University of California (Balderston 1973). Other institutions have found the choice sound for the university but unattractive to

students, which suggests that market effects as well as internal economies must be analyzed.

There are benefits to be gained from rationalizing student inputs, particularly for smaller institutions. Reduction of student dropouts and the higher degree completion rates that result represent a real increase in productivity. Selective admission toward this end may appear to be a retrogression to the 50s but times have changed radically since then. In many regions there is a very wide range of postsecondary opportunity that includes vocational-technical schools, 2-year colleges, and 4-year institutions. Admissions counseling that presents applicants with a full set of possibilities tailored to their abilities and interests can improve productivity throughout the system. Of course the same principle works within institutions where early counseling can replace trial-and-error course switching.

Lesser benefits are gained from two modifications in the use of facilities and fixed-cost services. They can be used more intensively or they can be put on a contract basis. The library, laboratories, and computing centers fit readily into patterns of independent learning and are rarely used to the economical limit. Joint usage among institutions through consortia or more informal arrangements are among the most promising aids to productivity. Most important, there is a great deal of experimentation underway in interinstitutional cooperation and evaluative studies will undoubtedly appear in large numbers over the next several years (Carnegie 1971). To the extent that support functions are not self-sufficient they can be contracted. Food service is the obvious candidate. Student health requirements can be covered by insurance, while student housing is another likely candidate. Changing student life styles and the departure of parietal rules have outmoded traditional dormitory design, thus outmoding the need for traditional dormitory space.

Economies of Scale

Economies of scale have an attraction of their own because they suggest a means of combining growth and economy. Maynard (1971) has analyzed institutional size and updates the older figures of Russell and Reeves (1937) to give a least-cost enrollment of about 5,400 fulltime equivalent students at a 4-year institution. Bell (1971, pp. 4-14) and his associates reject economy of scale as a general solution because the benefits curves flatten very quickly.

Based on cost-behavior studies, the Carnegie Commission (1972) suggests the following minimums: doctoral universities 5,000 to 20,000; comprehensive colleges 5,000 to 10,000; liberal arts colleges 1,000 to 25,000; community colleges 2,000 to 5,000. These are broad gage estimates. Smith (1972) has pointed out that philosophy and institutional style often take precedence over simple economies in numbers. Economies of scale deserve careful attention at the level of the degree program or other fundamental activity. The points of optimum efficiency differ among programs but they can be developed and should be a part of every internal evaluation.

Summary

Adjustments to inputs are the most promising sources of improvement in productivity over the short run even though few of them center on the teaching-learning process. One of the controlling inputs rarely mentioned and largely beyond manipulation is the supply of students. There is an assumption that students will arrive at the doors of colleges in proportion to the population in their age group. But the rate at which students enroll is what demographers refer to as a controlled rate. The element of control is student choice. This means that sharp and largely unpredictable changes in enrollment may appear over the next 5 years as some of the many pressures toward college enrollment lessen.

Outputs and Effectiveness

Productivity Adjustments and Outputs

What outcomes are and what they should be are under constant discussion in higher education. In the form of system outputs from programs and institutions they become the center of the productivity question. Adjustment to outputs that will improve the productivity ratio are of two kinds: (1) discovery or capture of real outputs that have gone unrecorded; and (2) changes in "product design and composition."

Almost every college or university that begin to rationalize and quantify its activities finds that credit-hours are not always accurately recorded. Students register too late to make the official counting date, audit without enrolling or, at the graduate level, use all facilities including faculty time without formal registration. On the faculty side, still other outputs, usually in the tutorial or counseling categories, elude the academic accounting system. The meticulous taxonomies and manuals developed under the auspices of WICHE *(Program Classification Structure, Data Elements Dictionaries, Faculty Activity Analysis)* will help close the credit-hour gap and identify elusive services that are part of real output. Because institutions have not been concerned about *demonstrating* outputs, a careful review of the practices by which activities are recorded and classified is likely to yield substantial results. Added benefits should emerge as faculty and staff are made conscious of the importance of performance indicators.

Changes in product design and composition are widely used in industry to improve productivity but few parallel opportunities exist in education (Gold 1955, p. 110). Diversification and specialization of product lines is a common approach and this has some bearing on higher education. A small number of experimental institutions for example, (the College of Human Services in New York City) have put aside the degree program as a universal format. Program options provide both paraprofessional and occupational preparation to the point of reasonable competence. Sometimes this includes award of a degree, but often it does not. In terms of the total system of postsecondary education this diversification of options improves the output of the whole

system. This is clearly an improvement in the effectiveness of the educational production process but it is more a concern of state systems than of individual institutions.

A number of suggestions for improving the efficiency of degree programs actually depends on a redefinition of outputs, yet there is an assumption, seldom admitted, that the change will not be significant. Shifting certification or credentialing to an external agency, for example, alters the character of a degree (Bell 1971). Acceleration may improve degree productivity for an institution but still leaves unanswered questions about the effects upon student development. Extensive credit for off-campus work has gained a measure of popularity. Under cooperative plans, where on-the-job experience as integrated within a total curriculum, there is no essential difference in the college experience of the student (Wilson 1961, p. 156; Knowles 1971). Under a less structured program of work-study, very different outputs may be generated.

Identification of Outputs

The outputs for education differ significantly from those of the goods producing and service industries and the extent of the differences must be assessed with some care. "The output of education is multidimensional with a vengence and to complicate matters, there are no convenient sets of 'prices' with which to aggregate the output" (Bowles 1970, p. 23). Business, too, has multiple goals beyond profits, including such outcomes as beneficent employee relations, good will in the community, market leadership, etc. (Thorelli 1960). Some are joint goals and others are competitive. Business has had difficulty identifying suitable proxies to represent its outputs and similarly so does higher education.

However, there is one difference that cannot be overstressed – the absence of a basis to establish either a hierarchy or a priority among outputs. Profitability is clearly the dominant output in business, with all other outputs related to it in various ways. Only when such an organizing concept is available can information be supplied from a review of past performance to improve future productivity. The problem for higher education, then, is not so much identifying *all* outputs as it is identifying a single priority output (Cartwright 1965). A consideration of five alternative economic goals other than profit is offered by Davis (1972) in the hospital setting, e.g., recovery of costs, maximization of outputs

and quality, utility, and cash flow. These goals suggest parallels to higher education.

It is a recent notion that outputs need to be identified with precision and related to the total production setting rather than merely equated with desired results. A major disillusionment of the 60s came with the realization that outputs everyone wanted and expected from education were often beyond demonstration. Study after study at all levels seemed to show that: "No matter what you do you can't affect . . . performance much" (Rivlin 1971, p. 72). "The rather simple input-output relations which—naively no doubt, but honestly—we had assumed to obtain in education simply, on examination, do not hold up. They are not there" (Moynihan 1971). First perceived as a problem in inputs, such as money, professional training, or organization, the principal difficulty now appears to lie with outputs, especially in defining and measuring them.

Without a means of identifying, measuring and putting into priority some selected group of outputs, it is impossible to manage an institutional system toward improved productivity. Weatherby (1971, p. 46) comments:

> We often confuse management with leadership to the detriment of both. Leadership is knowing where to go; management is knowing how to get there. Leadership is setting desirable objectives; management is discovering efficient methods of achieving these objectives. Leadership is charismatic, qualitative, idealistic; management is analytical, quantitative, pragmatic. Managerial tools are reproductive, exportable, and politically demonstrable while leadership is unique.

At this time the "outcomes problem," particularly at the institutional level, dominates the academic scene. It lies beyond the huge fund of management technique and yet it is fundamental to its operation. Recognizing its commanding importance, WICHE held a seminar that covered a wide range of opinion and speculation on the topic, forming an excellent introduction to the issue (Lawrence 1970).

The Differentiation of Outputs

Outputs are usually differentiated along two lines: (1) the level of the activity system that includes an individual student, a program or department, an institution, or society at large, and (2)

the class of activity such as research, teaching and learning, public service, administration, and management. Each of these items can be subdivided. Societal outcomes have been separated into economic and social benefits. The *economic* benefits of higher education have received increasing attention since 1960. Studies to assess the economic contribution of education tend to cluster around four main approaches (Anderson and Bowman 1965; Bowen 1964; Vaizey 1962). One is to correlate indexes of educational level with economic indicators like Gross National Product. Another is the residual approach that accounts for an increase in economic output in terms of measureable economic factors, then analyzes the residual effect to obtain an estimate of the educational contribution. A third approach treats educational expenditures as an investment on which rates of return, both direct and indirect, can be estimated. Income differentials among the various educational levels, for example, tell something of the projected return on educational investment. Finally, there is a manpower approach that examines the "stock" of manpower skill in relation to its use.

Social benefits, sometimes viewed as the indirect benefits or external economies, are a more recent concern. Keniston and Gerzon (1972, p. 52) distinguished a "technical component" of education that involves the process of socializing individuals toward social roles and a "critical component" aimed at liberating the individual so he can share in the creative modification of the culture. Others have suggested the need for outputs that emphasize pluralism to enrich the diffusion process so important in a changing society (Schon 1971, p. 84).

Institutional outputs present the most serious challenge since at that level resources are allocated and productivity is assessed. However, not only are outcomes difficult to identify but they are also hard to measure, since data from programs and from individual student performance are not easily combined into dependable indicators. A functional division separating instruction from research and public service has been introduced as a convenience. The point of concentration is instruction, although the role of research operations is receiving increasing attention.

At the *student* level there is a plethora of literature on the impact of college experience. Berls (1969) has given a brief summary of findings, while Feldman and Newcomb (1969) and Stern , (1970) present a more complete analysis. The

materials for evaluating student change and for assessing some of the influences of college experience is so complete that any institution can readily evaluate individual outcomes (Hodgkinson 1972; Folger 1972).

Arranging this detailed information about individuals to give a pattern of institutional outcomes is a problem that has engaged the National Center for Higher Education Management Systems (NCHEMS). The "outcomes project" has reached the stage of preliminary review and its aim is to (1) create a taxonomy of outcomes, (2) find a way of linking outcomes with programs and then to resources, and (3) to derive guidelines by which institutions can make their own analysis of resources and outcomes. Procedures are intended to be nonprescriptive and flexible enough to suit the priorities of individual institutions. An *Inventory of Higher Education Outcome Variables and Measures* is the basic descriptive catalog now in preparation. The *Inventory* is intended to be comprehensive, including not only student growth outcomes but also community and knowledge development outcomes.

Outcomes are attained not by direct application of resources but through programs that create a situation, an environment, or an operating unit so that a second typology is needed, such as an *Inventory of Institutional Environment Variables and Measures.* This identifies instructional/research variables, physical components, and social and economic constellations. It would alter the simple "INPUTS → PROCESS → OUTPUTS" idea by suggesting that inputs must be organized into a programmatic format or environment within which the process of production occurs, i.e., "INPUTS → ENVIRONMENT → PROCESS → OUTPUTS." To use this information an institution may select its own "profile" of outcomes and a set of measures appropriate to them. The outcomes are matched both to appropriate environmental conditions and to the measures associated with them.

Goal setting procedures and decisions remain at the institution and terminology and assessment procedures are standardized. This ingenious linkage of self-set goals, standardized outcome measures, and related environmental indicators may offer one way of describing institutional output more accurately if not more simply.

The need to define outcome without the guidance of a single directional principle like profits sets the productivity question in education apart. The effects are profound. The whole value of studying input-output ratios over time depends upon a stable definition of one element of the equation, preferably outputs. They may change in amount but their essential quality must remain the same or vary in known ways. With these conditions met, historical data provide information about the effects of productivity adjustments and a demonstration of long-term trends. Rises and declines in the amount of output reflect the effectiveness of the production process.

In education the absence of a single organizing principle for output that is stable over time, all but nullifies historical data. They are little more than incomplete descriptions, interesting but not reliable enough to permit generalized principles. Productivity analysis in the usual framework of comparing inputs with outputs after the fact is replaced by the process of planning. If outputs must be established *de novo* for each analysis, the exercise shifts completely from one of productivity adjustment based on past experience to a comprehensive operation of planning. The utility of the usual productivity question, Has it improved?, disappears and the central issue becomes, How can improvement be designed? The schematic for describing the issue now becomes: **OUTPUTS DEFINED → INPUTS → ENVIRONMENT → PROCESS → OUTPUTS ACHIEVED.** What productivity is to the business community, planning is to education.

The shift from a production mode to a planning mode has come very rapidly to higher education and its significance is not fully grasped. The impression gathered is one of an ongoing production process in education and incidental to it a planning activity. But if outputs must be specified, if one must "call the shots" in advance, then planning is the essential process and the production activity fulfills it.

Bowen (1972) put the matter succinctly: "Many discussions of efficiency come down not to how efficiently institutions are carrying out their present missions as they conceive them, but to what the mission should be." The goal-setting problem – whether labeled objectives, mission, aims, priorities, or directions – requires a decision. It is a prelude to planning and a precondition for management. Methods of reaching this decision range from

presidential decree to all-university committee. Some generally useful guidelines are the product of the "Priorities Committee" at Princeton University, whose efforts were aided by a Ford Foundation Demonstration Grant (Benacerraf et al. 1972). The committee concluded quickly that its function was a continuing one, essentially different from the usual governance functions. Out of the experience of the first 2 years came the ideas that a total view of the university must be the scope. Also equity and fairness with personnel should be high on the list of operating principles and the decisions would be set within foreseeable conditions. Apart from these, considerable attention was given to the "general tone and character" of committee actions and the uninhibited, candid discussion of the issues. The manner and the means of setting institutional goals or outcomes may vary, but the necessity of this activity and its unique character, separate from governance and a prerequisite to management, are clear.

Summary

Productivity adjustments to outputs are much less promising than manipulation of inputs. Careful identification of overlooked outputs can demonstrate the full measure of performance. A number of proposals suggest increasing the quantity of outputs, meaning degrees awarded, but only in conjunction with significant and largely undefined alterations in their quality and character. The most serious obstacle to productivity adjustments to outputs lies in their undefined nature at the institutional level and the absence of a clear organizing principle by which priority can be assigned.

Process Adjustments

Notes on the Production Process

In the industrial production process, outputs are well established and can often be converted into comparable monetary terms by pricing mechanisms. Priorities can be ordered around the dominant principle of profitability. Historical review of input-output ratios offers guidance for adjustments to improve productivity. These decisions can be made on the basis of limited information with assurance that their consequences, if significant, will appear in those ratios. Finally, the production process can usually be managed directly with both the settings and the behaviors of production subject to adjustment.

When this simplified analogy of production is applied to education, serious obstacles appear. Outputs in higher education lack a single dominant principle around which a hierarchy of outcomes can be designed. This means that historical analysis of input-output relationships have little value as a guide to productivity improvement. The need to define outputs in advance of any productive activity throws education into a planning mode but it demands a new set of policy decisions as a prelude to planning quite apart from management.

This condition has sweeping consequences. Instead of manipulating a small number of processes that history has shown to be crucial for production, the planning approach requires nothing less than a reexamination of the whole operating system. The seemingly endless demands of "management information systems" in education for another class of data or another crossover capability arise more from the needs of goal setting and planning than from the operating requirements of an institution. The basic information subsystems usually include data on students, finances, personnel and payroll (often with faculty separately classified), and facilities. When the system is carefully designed around an integrated data base, selected information from several files can be interrelated (*Education Commission of the States* 1972, App.).

If the outputs problem is the first obstacle to simplified application of a production analogy to education, then the second lies in the process itself. In the goods producing industries and

even in many service industries it is possible to manipulate or manage the events of production directly. Both the environment and the behaviors of individuals are under control. In higher education, the final stage of production is one of professional relationship with behaviors and judgments largely independent of management. Whether the item under production is instruction or research, the autonomous variables of a faculty member engaged in professional practice are a key to the final outcome.

Compared to the industrial situation, management efforts in higher education are peculiarly circumscribed. Decisions about outcomes, goals, or objectives must be made as a prerequisite to planning. Management control extends into the construction of an environment or setting for production, but the final process or behavior lies in the largely unmanageable realm of semi-autonomous professional practice. Plans to increase productivity by improving the production process must overreach the management process to include both the goal-setting process and the conditions of professional practice.

The Application of Management Technique

The scope of management in higher education may not be all-embracing, but many of the techniques have become indispensible tools for planning resource allocations. These techniques differ in one fundamental way – their capacity to deal with uncertainty.

If the outcomes are established and the steps to produce them clear, then *deterministic* models can be used. This "ideal" management situation seldom appears and most of the deterministic techniques have been modified to treat unknown or estimated factors. Common deterministic approaches include: (1) Program Evaluation Review Techniques (PERT), that emphasize careful scheduling of all the subprocesses required to reach a known objective. Time is the fundamental resource to be maximized. (2) Critical Path Management (CPM) adds another dimension by estimating probabilities for each completion time by permitting construction of schedule alternatives and calculation of the most efficient combinations (Archibald 1967). (3) Linear programming applies a rather restricted mathematical procedure that assumes all variables are linear, decisions being made under conditions of certainty. "The equations identifying the constraints of a given problem represent the limit upon the resources to be

allocated, while the objective function either maximizes or minimizes values consistent with the specific constraints. The purpose of the objective function is to find the optimal solution within the specified constraints" (Tanner 1971, p. 147). Modifications have been developed to include nonlinear problems and offer a choice of suboptimal as well as optimal solutions.

The conditions of uncertainty under which planning for resource allocation in higher education is pursued have suggested that *stochastic* techniques might be of value (Tanner 1971, p. 35). Mathematical models are rooted in present conditions but can be projected and elaborated by computer programming, they have proved to be the most useful approach to adjusting processes for improved productivity. Comprehensive models such as the CAMPUS Series, the Resource Requirements Prediction Models (RRPM), or SEARCH are gaining wide application. A brief description of the major designs is found in Kornfeld (1972), while more detailed references are available in Balderston (1973) and Mood (1972). These models are "student-driven" and display the effects of enrollment changes on faculty structure, course loads, and staff support requirements. Special models have been developed to project physical facilities requirements, library use rates, and faculty conditions. More recent developments incorporate optimizing functions that not only describe conditions but suggest the most effective alternatives (Balderston 1973, p. 44).

Systems Orientations

Once the implications of the planning mode are fully grasped and the component requirements of information, forecasting, and resource management apprehended, the pressure of simple logic suggests a systematic view that integrates all these activities. The organization is seen not as a structure but as a "process, a set of flows of information, men, material, and behavior" (Young 1971). Two major systems approaches have developed in higher education and one is an elaboration of the other.

Planning-Programming-Budgeting-Systems — Transmuted from its original applications in the Department of Defense, PPBS has been identified among the 61 important innovations of this century in the social sciences (Deutsch 1971). PPBS has been so widely considered and introduced during the past 5 years that only a brief description is required (Hartley 1968; Williams 1966).

A description of PPBS displays its virtues. "The heart of program budgeting is the grouping of activities by programs whose costs can be assessed and whose benefits to the institution can be identified" (Parden 1971). Other elements of the process require that the organization: designate goals and intermediate objectives leading to each goal; develop alternative plans for reaching the goal; estimate the resources required by each program alternative; assess the cost-benefits of each plan and of all plans in relation to each other (Huff 1969); compile the budget to support the selected plans; and review, revise, or continue on the basis of performance.

The key feature of PPBS is its cyclical review, not only of how well the budget is met, but of how intermediate goals of a nonfinancial nature are successfully achieved. PPBS is more than a set of techniques. Many of the inadequacies of practice are traceable to a disregard for the underlying concepts (Botner 1970). The most common violation of these concepts as well as the spirit of PPBS appears in the way practices are introduced. This is the point Wildavsky (1969, p. 193) made with his terse summary, "no one knows how to do program budgeting."

Ideally programs and goals are developed from the roots of the organization by taking advantage of local wisdom at every step. The ultimate decision group, therefore, has at its disposal a maximum amount of information plus the power to choose among the programs and the alternatives for achieving them. It must be constructed from the ground up. But the temptation is strong to forget the informational side and impose PPBS by central direction. The power of decision remains but the quality of decisions and alternative choices is fatally impaired. This leads to another visible flaw, namely, premature quantification of irrelevant items in an attempt to capture useful information. Many, perhaps most, of the efforts to achieve PPBS have failed on these points and end up being neither program nor budget.

There are also obstacles at the lower levels to match the formalism and intransigence at the upper levels of authority. The shift from budget-as-object to budget-as-instrument to support programs is well understood but often resisted. A former cabinet member, Lawrence F. O'Brien, commented on the introduction of PPBS into federal operations: "Many agency heads thought in terms of the appropriations structure since this was how resources were obtained. This thought pattern, which was frequently in conflict with the PPBS program structure, was reinforced by

Congressional insistence on the traditional appropriation structure and by the fact that the Department was organized along appropriations rather than program structure lines" (Botner 1970, p. 426). Experienced personnel in every organization develop strategies of trading information for resources and need time to adjust to new allocation procedures. In higher education there are still other problems: "While basic analysis is often very useful for educational decision making, . . . the organizational and political environments of most institutions of higher education effectively preclude full implementation of PPBS" (Balderston 1973, p. 34).

It is clear now that the promise of PPBS will never be fulfilled because the enormous machinery for a full-scale operation of the system is too costly in all respects. The Office of Management and Budget under George Schultz has moved away from PPBS for fiscal 1973 (Balderston 1973, p. 60). The name may disappear nearly as rapidly as it emerged, yet the essential features are too important to be lost. The benefits of linking resources with program activities, of subordinating fiscal convenience to program choices, and of encouraging the development of planning alternatives will be part of administrative thinking even if not accepted in the grand design of a total system (Farmer 1970; Andrew 1973).

The WICHE-NCHEMS Approach – Beyond PPBS and much more attuned to higher education are the comprehensive projects of the Western Interstate Commission on Higher Education. These efforts have expanded so rapidly in the past 3 years that it is as difficult to describe them as it is to assess their importance. Underlying the WICHE approach is the concept of the way information is structured and applied as the principal agent of management and control. In 1971, the change from WICHE-MIS to NCHEMS – the National Center for Higher Education Management Systems – signaled the extension of this philosophy into the full range of management.

Clearly national in scope, the intention is to "design, develop, and implement management systems and data bases" that will apply at the institutional level, to statewide systems, and to numerous federal programs (Lawrence 1972). The current list of NCHEMS projects is still heavily weighted (10 out of 33) toward standardizing terminology through taxonomies. Twenty of the projects are of direct interest to institutions. Attention to the interests of statewide systems or involvement with federal policy formation characterize nine projects. Modeling and systems design

engage seven projects, while manuals and procedures are the objectives of four activities. The efforts throughout have been herculean in scope and scrupulous in attention to detail, but they represent a prelude, an attempt to set a rational information base whose major impact necessarily lies about 5 years ahead (*NCHEMS* 1972).

A sample survey of users among institutions, statewide systems, and coordinating agencies has indicated widespread familiarity with three principal NCHEMS products; Program Classification Structure (PCS), Data Elements Dictionary (DED), and the Resource Requirements Prediction Models (RRPM). The highest levels of interest and use are found in systems and coordinating boards, institutions falling slightly behind (NCHEMS, 1972). This condition is understandable because statewide systems and coordinating boards are often starting information systems, while institutions face the task of replacing a system that is working, however imperfectly. Nevertheless, improvements in the production environment must occur at the institutional level and NCHEMS can affect productivity only if it continues to address the formidable problems at that level. There has been a major effort to disseminate procedures among institutions and a series of field demonstrations at that level is in progress.

There are additional reasons for reluctance on the part of institutions to adopt the total NCHEMS approach. One is the high cost; and until there is a clear prospect of recovering some share of the conversion costs through new efficiencies, that reluctance will continue. Introduction of NCHEMS procedures also shakes the pattern of power, temporarily perhaps, by shifting new influence to the technical expert. This rearrangement has obvious implications for the faculty, but it also alters the role of the traditional business officer; thus another source of reluctance is identified. Finally, some institutions may see small advantage to a system that displays every phase of operations in stark terms of comparability. Many of these factors duplicate the problems of introducing PPBS. They can be eroded by knowledge and familiarity, but the process is a gradual one. Nevertheless, if productivity in higher education can be improved by constructing more efficiently the environments for learning, research, and teaching, then the NCHEMS approach offers the best prospect for that change.

The Professional Situation

The utlimate stage in the production process, the point at which the professor, his field of knowledge, and the student meet, has several distinctive qualities. First, the primary consideration here is time effectiveness instead of cost effectiveness. The central concern is how the fixed amount of time available to professor and student can best be allocated and how the effects can be multiplied. Second, outputs at this level are not so unclear and difficult to define as at the institutional level. Student growth, socialization, and satisfaction can be assessed. Third, there is a marked existential quality to the experience of learning, with planning being a subordinate function.

For the professor, the process of instruction involves organizing knowledge, presenting and interpreting it, individualizing the learner's experience, and evaluating progress. Productivity adjustments to the presentation function and to evaluation offer an obvious way of improving time effectiveness. This is, of course, exactly what the paraprofessional teaching assistant does in the university setting. It does allow more time to the professor, but the multiplier effect is modest.

Improvement in the use of student learning time is almost as promising a prospect for increasing productivity as adjustments to faculty time use and, in the long run, may have broader impact. Application of educational technology, which includes all the electronic and mechanical means for packaging, storing, and presenting organized information, not only enriches the classroom and campus environment of the student, but provides a transportable learning environment over which the student has a high degree of control. Properly designed, they multiply professional effect many times.

Instructional areas such as laboratories, libraries, and computing centers absorb technology easily but for higher education as a whole the diffusion process has been slow, even "faltering" (Carnegie June 1972, p. 12). Cataloging and indexing are primitive, so there is a problem of accessibility (Oettinger 1972). The difficulty with technology is that it is not only revolutionary in its results but also revolutionary in its demands. Capital requirements are large, yet, more significantly, they appear to be impermanent investments likely to be outmoded long before amortization expires. Like the scale of investment, the scale of application required to bring reasonable payoff is beyond the level

of most systems of higher education. To bring the advantages to even a minimum level, faculty acceptance and understanding must be upgraded.

The curriculum and the classroom paradigm present a different kind of obstacle to the new technology. Both function now as closed systems, in that the content, structure, and timing are designed and controlled by the faculty. The parameters are known. The introduction of learning technology on a large scale would create an open system in which students moved at their own speed in directions that could not be anticipated. Much of what a faculty member encountered in his students and advisees would be unexpected. This openness might have great benefit, but it presupposes a transformation in the attitudes of the participants. Again, a revolutionary condition stands as a prerequisite to a revolutionary benefit.

Another condition must be considered in all designs for learning that depend heavily on student initiative. Bowen and Douglass (1971) have suggested that the differential productivity of students must be examined at some point. We may be able to produce an instructional system of very low cost only to find the student input so low that net productivity declines.

One by one these obstacles can be eroded as they have been in the area of computer application (Levien 1972). Potential for increased productivity through restructuring the learning situation and through professional practice are very high. Their realization depends upon how quickly a radically different set of preconditions are met.

Conclusions

In its simplest form of input-output relationships, productivity offers no absolute remedy to the financial problems of higher education. It may be at the institutional level too much was expected and the essential ideas stretched too far in the search for global indicators and convenient quantifications. Nevertheless, the productivity concept offers techniques that can be applied to higher education's needs.

- As a guide to adjusting monetary or nonmonetary inputs productivity has considerable utility. It helps distinguish adjustments from their consequences and encourages precise definitions of costs and benefits.
- The input-output approach has great value as an analytical tool where objectives are reasonably clear, the processes understood, and the activities subject to control. At the departmental or program level, it can be applied to considerable advantage.
- Ratios such as student-faculty, credit-hour load, cost per student, and others are well established indicators in the public domain and would be difficult to replace. In spite of their disturbing inadequacies, they can be used as a point of departure for explaining the full function of a modern university to its new publics.
- At the level of the individual student, a wealth of information has been developed by researchers and there is now good reason to establish some fundamental indicators around the input-output concept. There is little justification for aggregating such data, but they still have intrinsic value as indicators of the educational process.
- The discovery of unrecorded outputs offers one means of improving directly the demonstration of productivity at all levels.
- The need for institutional proxies for inputs and outputs is acute, and the aggregation of indexes from other levels is seriously misleading.
- The productivity idea is of little value in the comprehensive planning orientation that must of necessity engage the major efforts of higher education.
- The pursuit of improved productivity today is weighted heavily on the refinement of management systems. At best, this effort can touch only part of the educational process, namely, the efficient construction of an institutional environment. Far more attention is needed to the roots of management policy formation that necessarily involves the whole academic community. Equally

important and equally neglected are careful examinations of the conditions of professional practice for the scholar.

Surveying the material on productivity in higher education today, one begins by sharing the general observation of social historian William I. Thompson, "One can say almost anything about human culture now and it will be true, for everything is going on at once . . . " (Thompson 1971, p. ix). The increase in literature has been enormous in the past 3 years. Substantial progress has been made in standardizing terminology, refining concepts, opening communication, and winnowing out false leads. On closer scrutiny it is clear that much productivity activity is at the level of speculation and discussion or is confined to a small number of institutions. Even where the efforts of the NCHEMS dissemination process have been brought to bear, Bogard (1972) found the level of action modest. Only 24 percent of the institutions surveyed had an institutional research office, 13 percent had a computerized management information system, about a third had some form of planning-programming-budgeting, but only 2.8 percent had all three. This kind of modest change is similar to the resistance Dressel (1969) found in curriculum revision and the introduction of new programs at the graduate level noted by Harcleroad (1972). Widespread improvements in productivity will not take place until institutional experimentation with productivity techniques increases and successful methodologies are applied.

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